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DEVELOPMENT OF ELECTRONICALLY-TUNABLE
CONVERTERS IN THE MILLIMETER WAVE RANGE

CONTRACT NASw-790

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I T T E L E C T R O N T U B E D I V I S I O N
A Division of International Telephone and Telegraph Corporation

ELECTRON TUBE LABORATORY
Easton, Pennsylvania

CONTRACT NASw-790

DEVELOPMENT OF ELECTRONICALLY-TUNABLE
CONVERTERS IN THE MILLIMETER WAVE-RANGE

I. INTRODUCTION

Under this contract, the contractor shall conduct an experimental program for the development of electronically-tunable converters in the millimeter wave range. The work program in accordance with the statement of work has been summarized into four tasks as follows:

Task A

Investigate the intermediate-frequency effect on the conversion gain of a single-circuit converter.

Task B

Experimentally determine the characteristics of ridge-loaded, meander-line circuits partially or totally wrapped into a circular configuration.

Task C

Design and construct special purpose, backward-wave tubes in the 50 to 75 Gc range, suitable for operation as an oscillator, amplifier, or single-circuit converter.

Task D

Design and construct three double-circuited experimental backward-wave converters for operation in the 50 to 75 Gc frequency range. This shall be accomplished after completion of Task C.

At the present time Tasks A and B have been completed and the major effort is on Task C. The effort on Task D has been to order those tube parts not common to the Task C tube.

II. WORK ACCOMPLISHED DURING THE PAST INTERVAL

Task A

Complete.

Task B

During the last interval cold test measurements were made on an exactly scaled structure. The results of these measurements will be used in the testing of the Tasks C and D tubes. These cold test measurements complete Task B.

Task C

During the past interval the major portion of our effort has been concentrated on the spark machining of the slow wave structure. The most difficult portion of this work has been to get a suitable surface condition at the sparked areas. We have been working with two materials, namely copper and molybdenum, and have experienced unique difficulties with each one. In machining the copper the surface was marred by burrs as the electrodes passed through. Since subsequent deburring is not practical, the task here was to obtain burr-free cuts. After much experimenting this has finally been achieved by machining roll hardened unannealed material. The difficulty now is that if the copper circuit is chosen the assembly sequence may be troublesome in that we must first machine a circuit and then braze it to a circuit block rather than machine a complete assembly. Machining of the assembly is preferable in that further handling of the fragile circuit is avoided.

In the case of the molybdenum circuit the difficulty has been one of exfoliation, namely the fracturing of the material at the back side as the electrode cuts through. This was eventually eliminated by a light plating

however, uniform plating has been difficult to achieve. The final solution has been to obtain another source of molybdenum manufactured by a new and improved technique. Plating is not necessary with this material. A number of test cuts were made with good results before machining a full circuit. The first full circuits unfortunately were unusable due to a slight misalignment (.003 inch) during machining. The quality of the machining, however, and the pitch accuracy were quite good and it is expected that a suitable circuit will be obtained on the next try. Figure 1 is a photograph of this first full circuit. While the misalignment is not discernable, the quality and overall configuration can be judged.

In the preceding discussion it was pointed out that we are working with two possible circuit materials. The copper circuit is desirable due to its low electrical losses whereas the molybdenum circuit is desirable from the standpoint of ruggedness in that its physical strength is much greater while also possessing a much higher melting point. The final choice will depend both on the final quality of the machining and our ability to get good electron beam transmission. While either circuit may be acceptable, we have, in view of the spark machining difficulties, pursued both courses.

In addition to our efforts on the fabrication of circuits the balance of our labors on this task have been to work on all possible subassemblies. In particular, the output and collector subassemblies which represents a major portion of the overall tube fabrication have been completed.

Task D

During the past interval all those parts not common with the Task C tubes were ordered.

III. PROGRAM FOR THE NEXT INTERVAL

During the next interval all effort will be concentrated on the Task C tubes. In view of the encouraging results obtained with the first full molybdenum circuits, it is expected that the first tube will use this circuit. Work, however, will be continued on the copper circuits.

